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Variation in the terminalia of *Neohermes concolor* with a key to males of *Neohermes* in eastern North America (Megaloptera: Corydalidae: Chauliodinae)

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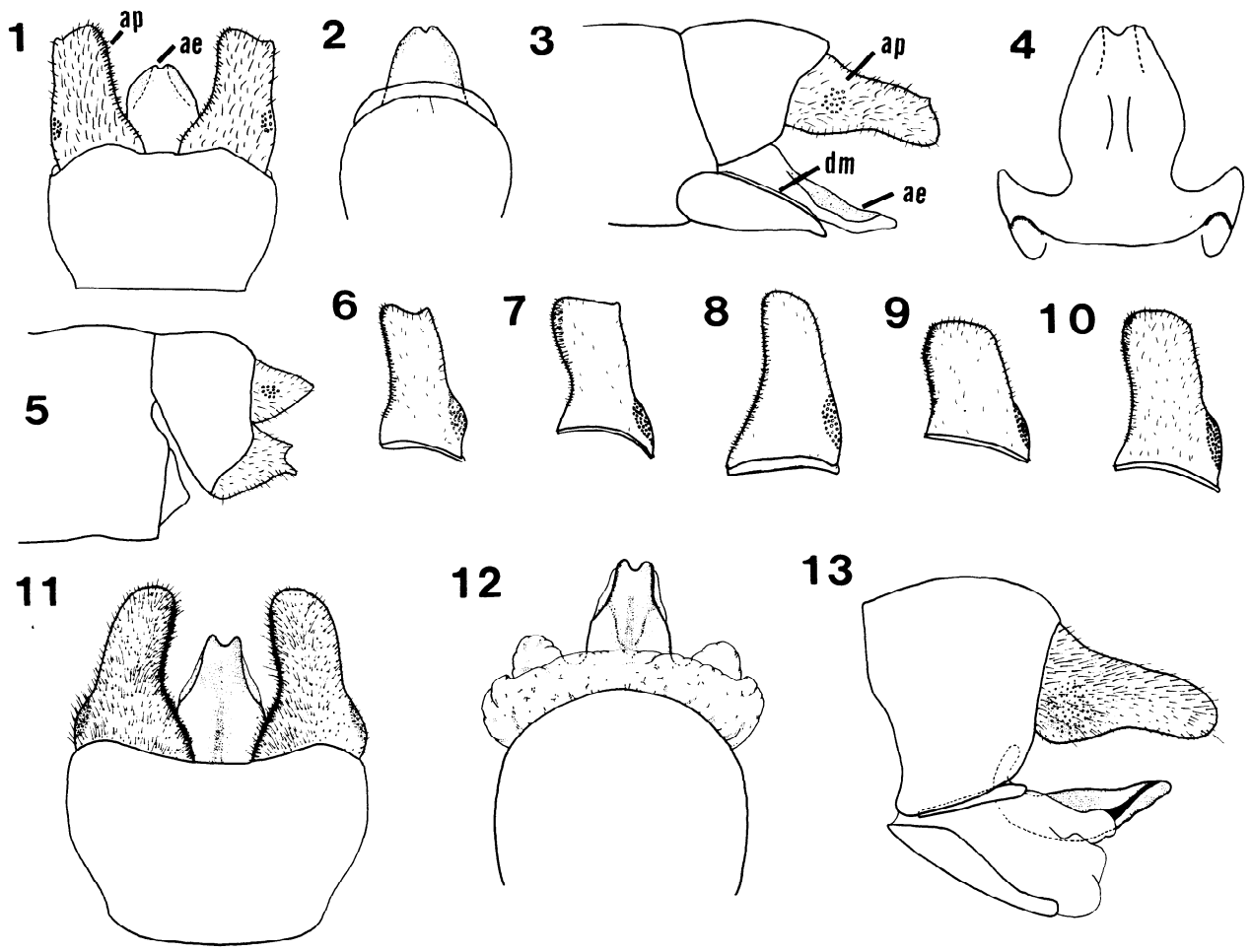
Abstract

Males of *Neohermes concolor* (Davis) from the interior highlands of Arkansas, Oklahoma, and Missouri, and from Illinois, Indiana, and Kentucky exhibited considerable variation in male terminalia. Differences occurred in the size of the dorsal membrane of the ninth sternite and in the shape of the tenth tergite (anal plate) which varied from rounded to truncate-shaped. This observed variation does not appear to be geographically correlated. Females of *N. concolor* did not exhibit broad variation in terminalia. Little variation was observed among males of *N. angusticollis* (Hagen) and *N. matheri* Flint. The broad range of variation observed in the terminalia of *N. concolor* could result in misidentification by collectors who rely only on the shape of the anal plate rather than the more constant shape of the aedeagus.

Introduction

The genus *Neohermes* (Megaloptera: Corydalidae: Chauliodinae) is represented by three species in eastern North America, *Neohermes angusticollis* (Hagen), *Neohermes concolor* (Davis), and *Neohermes matheri* Flint. The genus contains only two more species from western North America that form a group quite distinct from the three eastern species (Flint 1965). Of the eastern species, only *N. concolor* is widely distributed, occurring throughout the eastern United States (Tarter et al. 1976). *Neohermes angusticollis* is known only from Georgia and South Carolina (Flint 1965, Tarter et al. 1976); *N. matheri* has been reported only from Mississippi (Flint 1965, Stark and Lago 1983). Distributional records for all three species are limited because they are infrequently collected. Tarter et al. (1979) described the larval form of *N. concolor*. Typical larval habitats of this species include springs, seeps, and small, low-gradient woodland streams. Pupae of all three species are unknown.

In 1986, we collected an atypical male of *N. concolor* from Pulaski County, Missouri; the terminalia of this specimen differed substantially from other males collected from the same region and previously illustrated specimens of the species (Flint 1965, Stark and Lago 1983). Later, we examined a series of males from the interior highlands of Oklahoma and Arkansas that showed a broad range of variation in terminalia, including characters similar to those of the Missouri specimen as well as the commonly illustrated form of the species. We also examined two non-typical males from Kentucky, but males from Illinois and Indiana did not exhibit such variation. In addition, seven males collected from Randolph County



Figures 1-13. 1-5. *Neohermes concolor*. 1-3. Male terminalia. 1. Dorsal, 2. Ventral, 3. Lateral. 4. Aedeagus, dorsal. 5. Female terminalia, lateral. (ae = aedeagus, ap = anal plate (tenth tergite), dm = dorsal membrane of ninth sternite). 6-10. Anal plates of male *N. concolor* from different geographic locations showing a broad range of variation. All views are dorsal. 6. Latimer Co., Oklahoma, 7. Latimer Co., Oklahoma, 8. Nelson Co., Kentucky, 9. Pulaski Co., Arkansas, 10. Garland Co., Arkansas. 11-13. Terminalia of male *N. concolor* from Pulaski Co., Missouri showing rounded anal plates and expanded dorsal membrane of ninth sternite. 11. Dorsal, 12. Ventral, 13. Lateral.

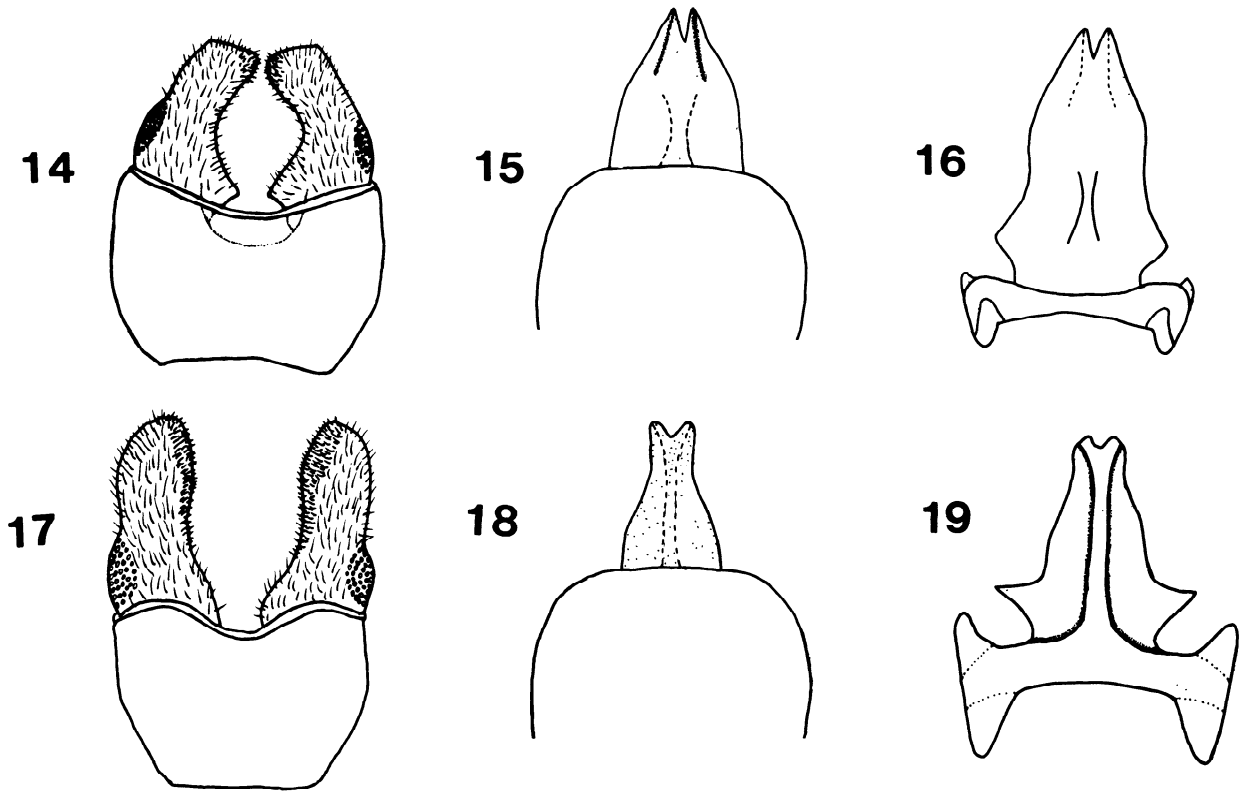
in Northern Missouri did not have atypical terminalia.

Variation in terminalia among males of *N. concolor* has been noted previously (Flint 1965), but no details regarding the degree of variation were provided. Herein, we illustrate the terminalia of the three eastern species of *Neohermes*, including some of the variation observed in males of *N. concolor*. A key to the males of *Neohermes* species of eastern North America also is provided.

We examined material from the Clemson University Entomological Collection (CUEC), Illinois Natural History Survey (INHS), North Carolina State University Entomological Collection (NCSU), Texas A&M University Entomological Collection (TAMU), United States National Museum of Natural History (NMNH), and University of Arkansas Arthropod Museum (UAAM). Other specimens of *N. concolor* examined by us are deposited in the Florida State Collection of Arthropods (FSCA).

Results

The commonly illustrated form of *N. concolor*, including female terminalia, is shown in Figures 1-5. Terminalia, as used here, includes elements of the ninth and tenth abdominal segments. Primary differences among specimens of *N. concolor* examined (n=32) include the shape of the anal plate (tenth tergite) and size of the dorsal membrane of the ninth sternite (Figs. 6-13). Anal plate shapes ranged from rounded to acutely truncate at the distal end (Figs. 1,



Figures 14-19. 14-16. *Neohermes angusticollis*, male terminalia. 14. Dorsal, 15. Ventral, 16. Aedeagus, dorsal. 17-19. *Neohermes matheri*, male terminalia. 17. Dorsal, 18. Ventral, 19. Aedeagus, dorsal.

6-11). In addition, the size of the dorsal membrane of the ninth sternite ranged from non-apparent (Figs. 2-3) to greatly expanded (Figs. 12-13) Minor differences were observed in the shape of the aedeagus among specimens, but they were so slight as not to warrant illustrating. Little variation was observed among the female specimens (n=22) (Fig. 5). No substantial differences in terminalia were observed among the male *N. angusticollis* (Figs. 14-16) or *N. matheri* (Figs. 17-19) examined (n=7, n=2, respectively). However, we saw only a few specimens of these two species, from limited geographic locations.

Discussion

The significant variation in the male terminalia of *N. concolor* that we examined could result in confusion with either *N. angusticollis* or *N. matheri*, particularly for collectors unfamiliar with these insects. The rounded anal plates of some *N. concolor* could result in confusion with *N. matheri*. Likewise, the broadly truncate anal plates of some males could be confused with *N. angusticollis*. However, the shape of the aedeagus was consistent among the specimens we examined thus allowing these three species to be distinguished. Also, the arrangement of short, dark setae on the mesal face of the anal plate was consistently different among the three species. Approximately one-half of the *N. concolor* males we examined had expanded membranes. This condition was observed in some live specimens and is not attributable to preservation in alcohol. Expanded membranes were not observed among specimens of the other two species.

The differences we observed in the terminalia of *N. concolor* did not appear to be geographically correlated. However, most of the specimens we examinined were collected from the interior highlands. Specimens from additional areas outside the interior highlands may show similar variation to be widespread. The same may be true for *N. angusticollis* and *N. matheri*. The phylogenetic significance of the observed variation in *N. concolor* is not clear at this time. However, *N. concolor* clearly demonstrates a

broad phenotypic plasticity with regard to the shape of the male terminalia.

Taxonomic Comments

The three eastern species of *Neohermes* are readily distinguished by the shape of the aedeagus. Likewise, the arrangement of short, dark setae on the mesal face of the anal plate is different in each species. In *N. concolor*, these setae occupy a narrow band running the entire length of the anal plate. The setal arrangement of *N. matheri* differs from that of *N. concolor* by occupying only the posterior three-fourths of the mesal face of the anal plate with the setal band widening near the tips. In *N. angusticollis*, these setae are restricted to the tips of the anal plate.

Material Examined

Neohermes angusticollis. USA. GEORGIA. Dekalb Co.: Atlanta, 19 June 1946, P. Fattig, 1 male, 1 female (NMNH), Brookhaven, 7 June 1953, G. Heid, 1 female (NMNH); Emerson, 14 June 1940, P. Fattig, 1 female (NMNH). Morgan Co.: Hard Labor Creek St. Park, Hard Labor Creek, 16 June 1969, Peters, Tsui, Pescador, and Jones, 1 male (NMNH). SOUTH CAROLINA: Greenville Co.: Greenville, 17-22 June 1968, P. Carlson, 1 male, 1 female (NMNH). Pickens Co.: Clemson, 7 June 1983, J. Brushwein, 1 male (CUEC), 19 June 1984, W. English, 1 male (CUEC), 25 June 1986, D. Dunavan, 1 male (CUEC); Charleston Co.: Charleston, 29 October 1983, P. Edwards, 1 male (CUEC).

N. matheri. USA. MISSISSIPPI. Claiborne Co.: Rocky Springs, 29 May 1979, B. Mather, 1 male (NMNH). Warren Co.: Vicksburg, 21 June 1973, B. Mather, 1 male (NMNH).

N. concolor. USA. ARKANSAS. Crawford Co.: Mountainburg, 11 August 1979, Bryan, 1 female (UAAM). Garland Co.: Camp Clearfork, 21 June 1988, R. Leschen, 1 male (FSCA); 21-23 June 1988, D. Bowles, M. Mathis, 2 males (FSCA); 17-21 June 1989, R. Cox, R. Tumilson, D. Bowles, 2 males (FSCA). Pulaski Co.: Little Rock, IH-430 bridge, June 1979, D. Johnson, 1 male (FSCA). Washington Co.: Fayetteville, 26 June 1988, D. Bowles, 1 female (FSCA), 25 August 1988, C. Klein, 1 female (FSCA); Springdale, 20 June 1930, S. Sumerland, 1 male (UAAM); Westfork, 2 mi SW, 2 July 1989, C. Carlton, 2 females (UAAM). ILLINOIS. Boone Co.: Columbia, State Road 163, 10 July 1975, S. Swadener, 1 female (INHS). Pope Co.: Dixon Springs, 1.5 mi W, Glendale, 27 June 1979, D. Webb, 6 males, 1 female (INHS). INDIANA. Monroe Co.: Bloomington, 14 July 1961, D. Lockwood, 1 male (TAMU). KENTUCKY. Nelson Co.: Bardstown, 19 June 1971, A. Brower, 1 male (NMNH). Boyd Co.: July 1972, W. Watkins, 1 male (NMNH). MARYLAND. Prince Georges Co.: College Park, 2 June 1966, L. Deitz, 1 female (NCSU). MISSOURI. Pulaski Co.: Gasconade River, near Richland, 28 June 1986, M. Mathis, D. Bowles, 1 male (NMNH). Randolph Co.: 1 mi E Moberly, 1-7 Jul 90, E. Riley, 7 males, 2 females (TAMU). OKLAHOMA. Latimer Co.: Red Oak, 5 mi SW, 9-15 May 1988, K. Stephan, 1 female (FSCA); 11-25 June 1988, K. Stephan, 6 males, 5 females (FSCA), June 1989, K. Stephan, 3 males, 5 females (FSCA). TEXAS. Bowie Co., Red River Depot, 1 female (CUEC).

Key to the adult male *Neohermes* of eastern North America

(modified from Flint 1965 and Stark and Lago 1983)

1. Aedeagus having prominent central ridge, with lateral margins strongly sinuate (Fig. 19); anal plates rounded apically, short dark setae occupying posterior three-fourths of anal plate, widening towards tips (Fig. 17) ..... *N. matheri*

1'. Aedeagus and anal plates other than above (Figs. 1-4, 6-16) 2

2. Aedeagus with deep basolateral excisions; tip with slight mesal excision (Fig. 4); anal plates variable in shape (Figs. 1, 6-11), short dark setae occupying a narrow band along entire mesal face of anal plate ..... *N. concolor*

2'. Aedeagus with shallow basolateral excisions (Fig. 16); tip with deep, V-shaped narrow mesal slit; anal plates truncate apically, short dark setae occupying mesal face only at tips (Fig. 14) ..... *N. angusticollis*

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